

20 The cheetah, *Acinonyx jubatus*, is a member of the cat family, Felidae.

Cheetahs display less intraspecific variation than other members of the family Felidae.

Fig. 20.1 shows the mean body length of a population of cheetahs from southern Africa.

The error bars on Fig. 20.1 show the standard deviation of mean body length.

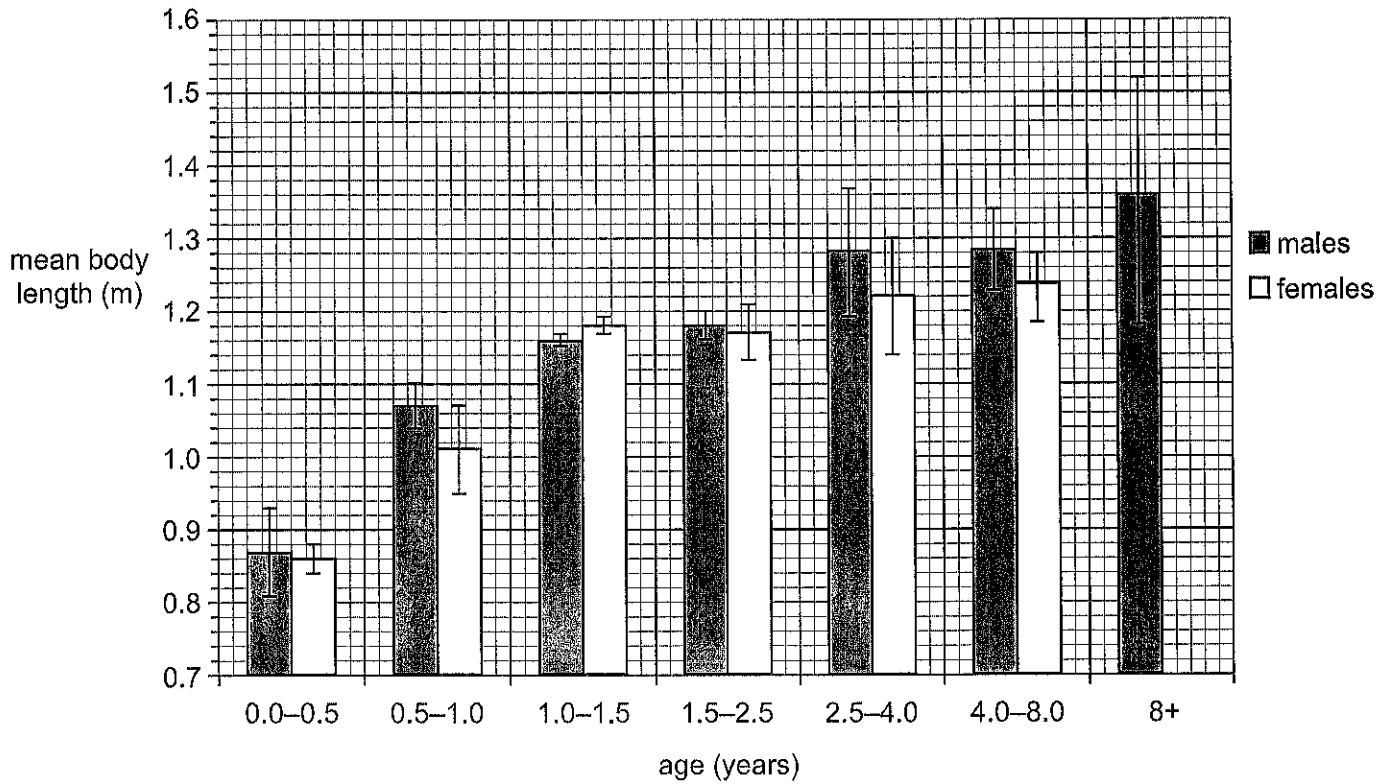


Fig. 20.1

- (a) (i) At between 2.5 and 4 years old, the mean length of female cheetahs is less than that of males.

Calculate how much shorter than males female cheetahs are.

Show your working. Express your answer as a percentage to **two significant figures**.

Answer % [2]

- (ii) Using only Fig. 20.1 and your answer to (i), what can be concluded about the **significance** of the difference between the length of male and female cheetahs aged between 2.5 and 4 years?

Explain your answer.

.....
.....
.....
..... [2]

- (iii) A student looked at Fig. 20.1 and wrote:

"The longest male cheetah that was measured was 1.52 m long".

Explain whether the information in Fig. 20.1 supports the student's answer.

.....
.....
.....
..... [1]

- (iv) State the likely causes of variation in body length in cheetahs.

.....
.....
.....
.....
..... [2]

- (b) The population of cheetahs has been declining for the past 100 years and is estimated to be between 6000 and 7000.

Within the remaining cheetah population, intraspecific genetic diversity is very low.

One isolated population of cheetahs in Iran has fewer than 100 individuals.

- (i) State one way in which genetic diversity can be measured.

.....
..... [1]

- (ii) It is thought that the modern cheetah population has low genetic diversity because the population, relatively recently, experienced a genetic bottleneck.

Explain why a genetic bottleneck can lead to low genetic diversity.

.....
.....
.....
.....
.....
..... [2]

- (iii) Scientists are concerned about genetic drift in the remaining cheetah populations.

Explain why genetic drift is likely to be of particular concern in the population of 100 cheetahs in Iran.

.....
.....
.....
.....
..... [2]

(c) Madagascar is a large island off the coast of Africa that once formed part of the mainland.

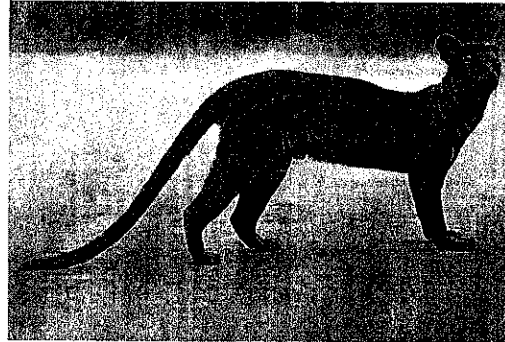
The fossa, *Cryptoprocta ferox* is the top predator on Madagascar.

The fossa shares many physical similarities with cats but it is not a member of the family Felidae. It is related to the mongoose.

The mongoose is a much smaller mammal that lives on the African mainland.

Fig. 20.2 shows a fossa and a mongoose.

fossa



mongoose



Fig. 20.2

(i) The mongoose is a smaller mammal and also has proportionally longer fur. State **one** other difference, **visible in Fig. 20.2**, between a fossa and a mongoose.

.....

..... [1]

Mark Scheme

H420/02

Question	Answer	Marks	AO element	Guidance
20 (a) (i)	4.7 ✓ ✓	2	AO2.6	Max 1 if answer not given to 2 s.f. IGNORE sign If answer incorrect ALLOW 1 mark for 4.8 or 4.9
(ii)	little / nothing (can be concluded) ✓ because no (named) statistical test done ✓	2 max	AO3.1	IGNORE 'not significant' if no other marks awarded, ALLOW 1 mark only for... (probably) not significant because, <u>error</u> bars / standard deviations, overlap
(iii)	No, because... idea that standard deviation is not the same as range ✓	1	AO3.2	ALLOW e.g. SD does not include all outliers / error bars don't show range
(iv)	environment ✓ genes / genetic / alleles, and environment ✓ many genes / polygenic ✓ age ✓	2 max	AO2.1	ALLOW suitable example, e.g. diet Note 'genes and environment' = 2 marks IGNORE refs to mutation
(b) (i)	genetic polymorphism / proportion of heterozygotes / proportion of gene variants ✓	1	AO1.1	CREDIT number of polymorphic genes
(ii)	(many) <u>alleles</u> lost (when population dropped) ✓ ora (modern population) descended from few survivors / AW ✓	2	AO2.5	ALLOW few alleles were left after drop in population ALLOW cheetahs still alive descended from a small gene pool IGNORE founder effect unqualified

Question	Answer	Marks	AO element	Guidance
(iii)	<p>idea that one individual or allele has proportionally higher effect on small population ✓</p> <p>(more likely that) <u>alleles</u> will be lost from population ✓</p> <p>(population) more vulnerable / likely to become extinct due , to environmental change / AW ✓</p>	2 max	AO1.2	<p>IGNORE founder effect unqualified</p> <p>ALLOW example of environmental change E.g. might become extinct because of (new) disease IGNORE event</p>
(c) (i)	<p>Fossa has ... longer , legs ✓ different (shaped / size) , ears ✓ (proportionally) bigger eyes ✓</p>	1 max	AO2.3	<p>Mark the first response only Assume 'it' refers to <i>mongoose</i> IGNORE references head / body / shape ALLOW ora for mongoose throughout</p>
(ii)	<p>1 allopatric speciation ✓</p> <p>2 different , selection pressure / environmental conditions (from mainland) ✓</p> <p>3 (random) mutation ✓</p> <p>4 (fossa-like) individuals with , mutation / (new) feature , survive / reproduce ✓ ora</p> <p>5 beneficial / AW , <u>alleles</u> passed on ✓</p> <p>6 <u>directional</u> selection ✓</p>	4 max	AO2.5	<p>3 ALLOW pre-existing genetic variation 4 IGNORE best adapted / fittest</p>

Mark Scheme

H420/02

Question	Answer	Marks	AO element	Guidance
(iii)	mutation / genetic diversity ✓ natural / directional , selection ✓ idea that environment / selection pressure , is different from the 'other' population ✓ time ✓	3 max	AO1.2	IGNORE refs to isolation ALLOW genetically different / large gene pool ALLOW e.g. different food source ALLOW many generations
Total		21		

Question	Answer	Marks	AO element	Guidance
21 (a)	working out the sequence / AW , of nucleotides / bases ✓	1	AO1.2	IGNORE base pairs
(b)	100 000 000 / 100 million / 1.0×10^8 / 1×10^8 ✓ ✓	2	AO2.6	ALLOW 1 mark for 100 000 / 1×10^5 / 10^8
(c) (i)	high throughput sequencing ✓ shotgun sequencing ✓ whole genome sequencing / WGS ✓ next generation sequencing / NGS ✓ pyrosequencing / use of luciferase ✓ massive parallel sequencing ✓	1 max	AO1.2	ALLOW swapping radioactive tags for fluorescent tags